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Tosmana

TOol for SMAll-N Analysis

version 1.25

User Manual

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1. Introduction

Within this document the reader will find a short guide to get started with the Tool for Small-N Analysis *Tosmana*. Although the basic features of QCA, the main method implemented in *Tosmana,* are described, this is not a general introduction to this method. QCA was first introduced to the social sciences by Charles Ragin with his book "The Comparative Method"[1] where he sought to move beyond the qualitative-quantitative gap, by introducing a new method to combine the strengths and to reduce the problems of either approach. This resulted in *Qualitative Comparative Analysis – QCA.* The main goal of QCA is to reduce the complexity of data sets by using Boolean algebra. Since 1987 several software programs have been created to implement this method. In every new program several things had changed: New algorithms have been introduced and more powerful computers allowed extending the limitations regarding the number of conditions to be treated simultaneously. With *fs/qca* (Fuzzy Set Qualitative Comparative Analysis) a graphic user interface (windows style) was used for the first time, and the 12 variable limit of QCA3 was overcome.

Tosmana also implements classical Boolean algebra, but it seeks to tackle one of the main limitations of QCA - its restriction to Boolean sets: Every element of a data set has to be T (true) or F (false), but often we want to use more condition values like {*low, medium, high}*. Therefore *Tosmana* introduces *Multi-Value Minimization* as an additional feature of *Boolean Minimization*, but it also can be used for Boolean Minimization. As this is a software manual, the method as such is not discussed here, but the user should read available introductions to Multi-Value Minimization.[2] Please also visit the *Tosmana* resource site, where a list of further readings is found.

As *Tosmana* is work in progress, many details of the software are subject to changes.

[1] Ragin, C. C. (1987) The Comparative Method. Moving Beyond Qualitative and Quantitative Strategies, University of California Press, Berkeley.

[2] Cronqvist, Lasse (2003): "Using Multi-Value Logic Syntheses in Social Science". Paper presented at the 2nd General Conference of the European Consortium for Political Research (ECPR) Marburg:. Found on http://www.tosmana.net/resources/.

2. Installing Tosmana

Tosmana is using the *.NET Framework,* a programming platform provided by Microsoft. The advantage of using this framework is that it takes care of many details of the software creation, so that the programmer can concentrate on the central topics. This means that creating *Tosmana* is much faster with *.NET* than without a programming framework. But this also means that the user has to install a version of the *.NET Framework* if there is no such framework already installed on the system. In this chapter the reader will therefore, first find an instruction on how to install the *.NET Framework* and then an instruction on how to install *Tosmana.* If you have trouble installing any of the parts mentioned, you should contact the *Tosmana FAQ* on the *Tosmana* resource site, where you also are able to contact the programmer (see chapter 6). The *Tosmana* resource site is found at the following URL:

Tosmana resource site: http://www.tosmana.net

Installing the .NET Framework

Tosmana requires the *.NET Framework* to be installed on your computer to be able to run. The Framework works with all recent versions of Windows (Windows98 and later), and is distributed by Microsoft for free and can be downloaded from the Microsoft site. On the *Tosmana* resource site there is a direct link to the *.NET Framework* download page, on which you find detailed information on software requirements and installing instructions for the framework. Below you will find a short step-by-step instruction for installing the *.NET Framework* that should be sufficient for most users. The framework comes as one large file (~ 20 MB), which has to be downloaded before starting installation. The framework also requires some other software installed on the system, please see the exact description on this and how to install it on the Microsoft site (follow the link on the *Tosmana* download site).

Installing the .NET Framework SDK step by step

(1) Where applicable (Windows2000, NT, XP): You have to be logged in as an administrator on your system to be able to install the framework.

(2) Download the .NET framework onto your system. A link is found on the *Tosmana* site.

(3) Execute the file *dotnetredist.exe* just added to your system. Please read and accept the end user licence agreement (*EULA*) of the *.NET Framework* by Microsoft and then choose a directory to extract the installer. Please note where you placed the installer.
(4) After the installer has been extracted, you can install the framework by starting the installer (*dotnetfx.exe*) from the windows explorer.
(5) If you are asked to restart your computer: do so.
(6) If the installation was successful you can now install the *Tosmana* software.

Please note that you will only have to install the framework once. When you update the *Tosmana* software at a later stage you will not have to reinstall the framework.

Installing the Tosmana software

With the *.NET Framework* installed you can download the current version of *Tosmana* as a zip file from the site mentioned above. Please extract the two files included in the zipfile to a directory of your choice. Please ensure that both files are extracted.

3. Constructing your data set

If the *.NET Framework* is installed correctly, the *Tosmana* preview can be started easily by running it out of the windows explorer like any other Windows program. When *Tosmana* is started the main window shows up, in which data files are created, loaded and saved, and from where the calculation window is called. In this chapter the features of the main window are described.

When you start *Tosmana* you are asked if you want start with a new file or load an existing data set. If you which to load a file previously edited with Tosmana, select *Load a data set*. In any other case please select *Empty data set.* If you would like to start with an import from excel or SPSS, please select *Empty data set* and then import the file from the main window.

Loading and Importing Data

Loading a file into Tosmana

A file created (and saved) by *Tosmana* can be loaded by selecting *File* > *Open* from the menu bar in the main window. Please note that only files created with *Tosmana* and saved in the XML (extended mark-up language) file format can be loaded with the *Open* item. Please refer below on how to import files from other programs (Excel, SPSS).

Importing from Excel

By selecting *File* > *Import* > *Excel* a CSV-File saved by Excel can be imported to *Tosmana* (This feature has been tested with Excel97 and Excel2000, but it should work with other releases as well). First, you have to assure yourself that a variable is included which can be used as Case-ID for your data set. To import data from Excel to Tosmana please follow these instructions:

In Excel:

1. Open the data set in Excel.
2. Switch to the sheet which is going to be exported to Tosmana
3. Select *File* > *Save As.* Select *"CSV-File (*.csv)"* as *File Type* in the save dialog window.
4. Type the filename to be used, save the file.
5. Close the worksheet

In Tosmana

In *Tosmana* select *File* > *Import* > *Excel* and select the file just saved. The import feature of Tosmana recognises the variable type (case descriptors, interval scale, ordinal scale). You can review these settings and then the data appear in the *Tosmana* Main Window. You should then save the data as a *Tosmana* XML-file.

Importing data from SPSS

Also SPSS .dat files can be imported with *File* > *Import* > *SPSS-Data (*.dat).* As with Excel imports, you first have to assure yourself that a variable is included which can be used as Case-ID for your data set. Please also notice that all variables are considered to be of a nominal type. You may change this in the "variable settings" section (see below). To import data from SPSS to Tosmana please follow these instructions:

In SPSS:

1. Open the data set in SPSS.
2. Select *File* > *Save As.* Select *" Tab-Limited *.dat"* as *File Type* in the save dialog window.
3. Type the filename to be used.
4. Save the file.

In Tosmana:

In *Tosmana* select *File* > *Import* > *SPSS-Data (*.dat)* and select the file just saved. The data should now appear in the *Tosmana* Main Window. You should then save the data as a *Tosmana* XML-file.

Importing from fs/qca

By selecting *File* > *Import* > *Excel or fs/qca file* a DAT-File saved by fs/qca can be imported to *Tosmana.*

First, you have to assure yourself that a variable is included which can be used as Case-ID for your data set. Please also notice that all variables are considered to be of a nominal type. You may change this in the "variable settings" section (see below). To import data from fs/qca to Tosmana please follow these instructions:

In Excel:

1. Open the data set in fs/qca.
2. Select *File* > *Save As.* Select *"comma"* as *File Type* in the save dialog window.
3. Type the filename to be used.
4. Save the file.

In Tosmana

In *Tosmana* select *File* > *Import* > *Excel or fs/qca file* and select the file just saved. The data should now appear in the *Tosmana* Main Window. You should then save the data as a *Tosmana* XML-file.

Creating and saving files

By selecting *File* > *New* a new *Tosmana* data set will be created. You can add variables to the data set by selecting *Dataset* > *Enter new Variable* from the menu bar. As soon as all variables are added, you can add the cases of the data set simply by entering them in the data matrix of the main window. To change the Variable name you have to enter the *variable edit* window described below.

Selecting File > Save in the main menu bar saves the data set. If you wish to use your data set in other applications (Excel or fs/qca) you may also save the file as a csv or dat file (choose *Export*).

Editing the data set

You might change the content of the data matrix at any time by changing the data in the main window. Please note that you have to open a new calculation window to use the new data in your calculation. If you want to add a new row (case), just enter the data in the last row of the data set. If you wish to delete a case, click on the row header of the case you wish to delete and press the delete button on your keyboard.

Adding and editing variables

To add a new variable please select *Dataset* > *Enter new variable*. Edit the name of the new variable and press *ok*. The new variable will then appear in the data set.

If you wish to change the attributes of an existing variable, please change to *Variable View* by selecting *Edit* > *Variables Settings.*

- To change the name of the variable click on the button labelled *change name* and enter the new variable name.
- To remove a variable entirely, select the variable name in the *Variable Settings* window and press the button labelled *remove.*

- You may add a description to a variable in the *description field.*
- *Ordinal / Nominal data:* If you just work on Boolean data sets, you do not have to think about if your variable is of a nominal or ordinal type, but when you are using Multi-Value data sets you should be aware of the differences in calculation with those different types of variables (see chapter on “set notation” below).

Replacing multiple data entries

If you wish to replace multiple data cell entries with the same value, you may do so using the replacement window (select *Edit > Replace)*. Define the search value and the new value to replace it and select all variable where this replacement is done. Press *ok* and the replacement will take place. You can use this feature to change the missing data value in the data set to the needed '-' in TOSMANA all at once.

Variable transformation

The menu item *Transformation* in the *Variable Settings Window* defines how the raw data is converted to the data used by MVQCA. There are four different options, which can be set for each variable:

- *use original values (1:1):* Using this option indicates that the raw data is used as it is with MVQCA. If you are importing a data set from SPSS or you are creating a new data all variables will be set to this option Please note that all data must be of numerical type and that missing data always has to be noted with an '-'. Variables containing the name of the cases should be set as *use as case ID*. If this is not the case Tosmana will produce errors.
- *no Transformation possible:* If this option is set, the variable can not be transformed and it can not be used with the software. The sense of this is to exclude variables which can not be translated by the standard rules yet but which may be used in future (like calendar dates etc.)
- *use as case ID:* If this variable is set, the variable can only be used as case ID.
- *use Thresholds:* If this variable is set, you can use the threshold setter described below to set the thresholds dynamically while working with TOSMANA. Please note that all data must be of numerical type and that missing data always has to be noted with a '-'.

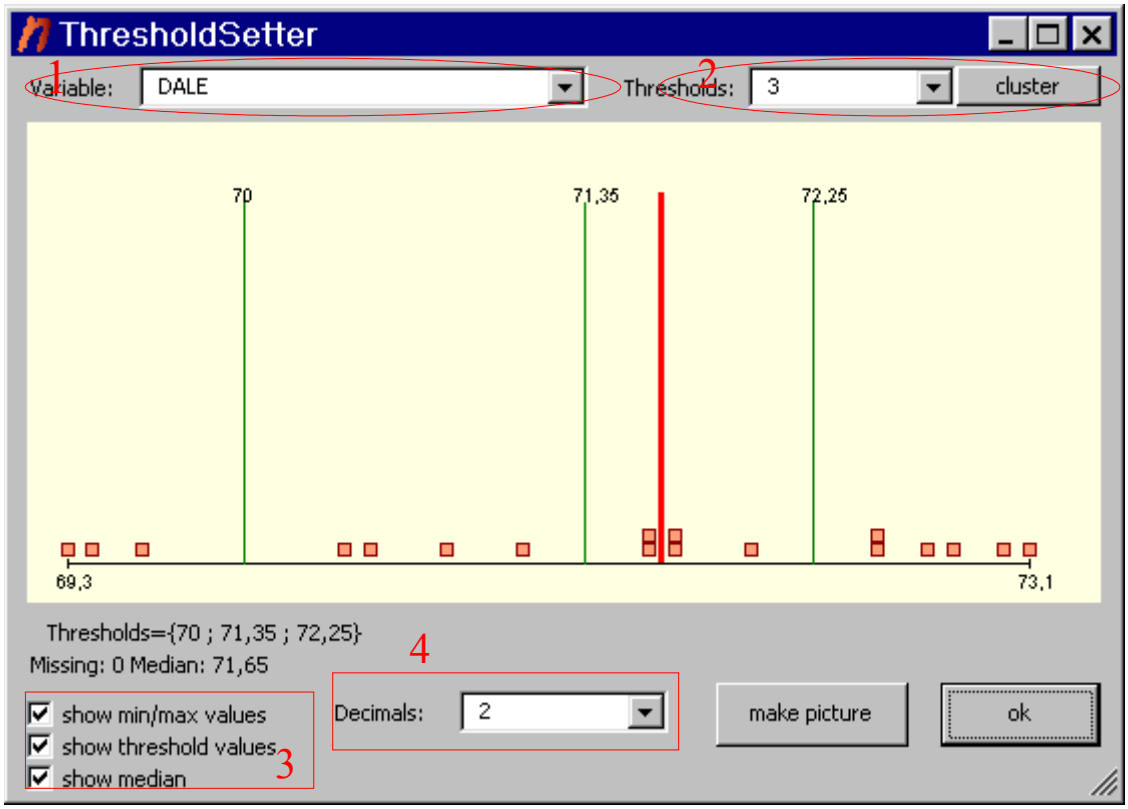
Transforming Scale Data

To transform scale data to stepped conditions suitable for MVQCA analysis, thresholds must be set to recode the data. TOSMANA provides two ways to do so: Thresholds can be set directly by hand or thresholds can be set interactively by using the 'Thresholdssetter'.

To set the thresholds directly, choose *Edit* > *Variable Settings* from the menu bar and select the condition to set the thresholds (double click the row header). If the option “use thresholds” is selected as transformation mode, the button *edit* can be pressed. The thresholds are entered by using '.' (dot) to separate decimals and ';' to separate multiple thresholds.

Using the "Thresholdsetter" Window

If one or more Variables are containing data, which is scaled on an interval scale, the data must be transformed to an ordinal scale before it can be used with MVQCA. To do this, the variable must be set to be transformed with threshold(s) in the *Variable Settings* window (set the *Transformation* item to *use Thresholds).* Then the *Threshold Settings Window* can be opened with *Tools* > *Thresholdsetter* in the main window. Please note that only missing data noted by '-' will not be shown in the threshold setter.



In the central panel the distribution of data is shown. Each orange box represents one case. The green lines represent the thresholds. If the option is set (lower left corner, the values) the values of the thresholds are noted above the threshold line. The number of decimals shown can also be set (4). The thick red line is the median (the line can be toggled on / off with the

option in the lower left corner (3)). To select a different variable, please use the dropdown menu at the upper left corner of the window (1).

To move the threshold simply place the mouse on the wanted threshold (the mouse pointer will change) and press the left mouse button. The move the line by moving the mouse (still pressing the left button) and release the mouse button with the value wished.

The number of thresholds used with the variable can be selected with the dropdown list in the upper right corner (2). By clicking the *cluster* button a simple clustering (average linkage) will be performed on the variable data.

Recode Stepped Conditions

To recode a stepped condition into a new condition, select *Tools* > *Recode Condition* from the menu bar. Select the condition to be recoded and check the proposed name of the new condition. By selecting the "old" values found in the left box, these might either be used unchanged in the new condition (*"1:1"* button) or assigned new values (enter the new value in the text field under the *Convert to* button and press this button. If you wish to undo a coding, select the recode expression in the right box and press the *undo* button.

4. Data Analysis

The main goal of *Tosmana* is to perform minimization on Boolean and on Multi-Value Data sets. This is done from the analysis window (named *(MV)QCA*). Call the analysis window from the menu bar: *Tools* > *Start (MV)QCA*.

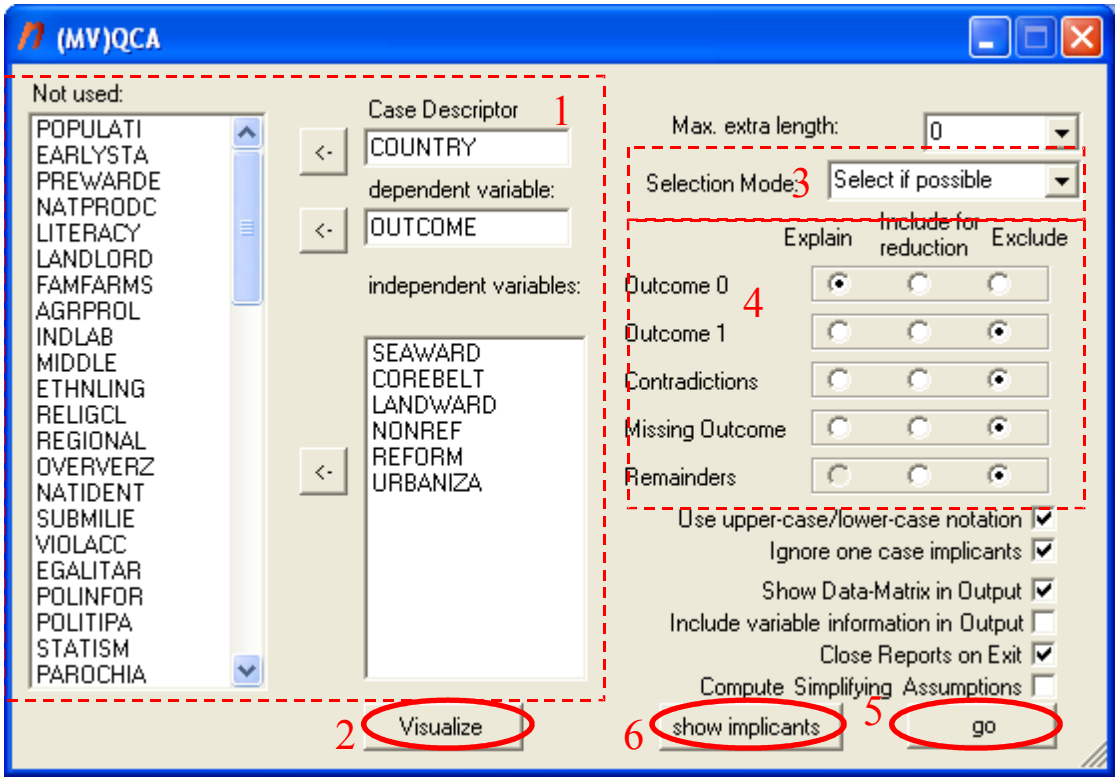


Figure 4-1 The (MV)QCA Window

Selecting variables for analysis

Before the calculation can be done, the variables for the analysis have to be chosen (red box 1 in figure 4-1). Use the arrow buttons to select the outcome and the conditions. Please note that the use of a case descriptor is necessary in *Tosmana.* Variable values have to be of the type {0,1} for Boolean analysis and {0,..,n} for multi value analysis. If you choose a variable with non-numerical data as outcome or condition, an error window will show up.

Visualizing your data

Up to five conditions can be displayed in a graph by pressing the *visualize* button (2). See the chapter on the Visualizer below for details.

Selecting the calculation style

Tosmana provides you with three different ways to calculate solutions, which can be selected with the *Selection Mode* drop-down box (3):

(1) All solutions are calculated and displayed in the result report (*Show All*)

(2) When more than one solution is possible, the user can select the prime implicants used in the *manual selection* window (see below), but *Tosmana* ensures that the solution is minimal (*Select if possible*)

(3) The user may combine the solution freely in the *manual selection window*, but this means that the solution does not have to be minimal. (*Free selection*).

Calculation configuration

The configuration of the calculation can be set in the right half of the *(MV)QCA* window (4). The configuration labels are to be understood as follows:

- *Explain:* Those outcomes which are explained by the solution (in QCA2: *Matrix to be minimized)*
- *Include for reduction:* Outcomes allowed to be included in the reduction of the implicants (in QCA2: *Matrix for computing Prime Implicants* – please note that outcomes to be explained had to be included in this matrix in QCA2, in QCA3: "don't cares").
- *Exclude:* Outcomes, which are excluded from minimization.

Select Notation

Regularly, Tosmana shows the expressions in the solution with strict set notation. If the option *Use upper-/lowercase notation* is checked, the notation used with QCA2 and QCA3 can be used instead.

Show Implicants

To only get a list of the prime implicants press the *show implicants* (6) button. In the prime implicant window coming up you can then see the prime implicants for your selection of conditions and settings. You may filter the list by cases. With a click on a prime implicant in the list the cases implied by this implicant are shown.

Starting the calculation

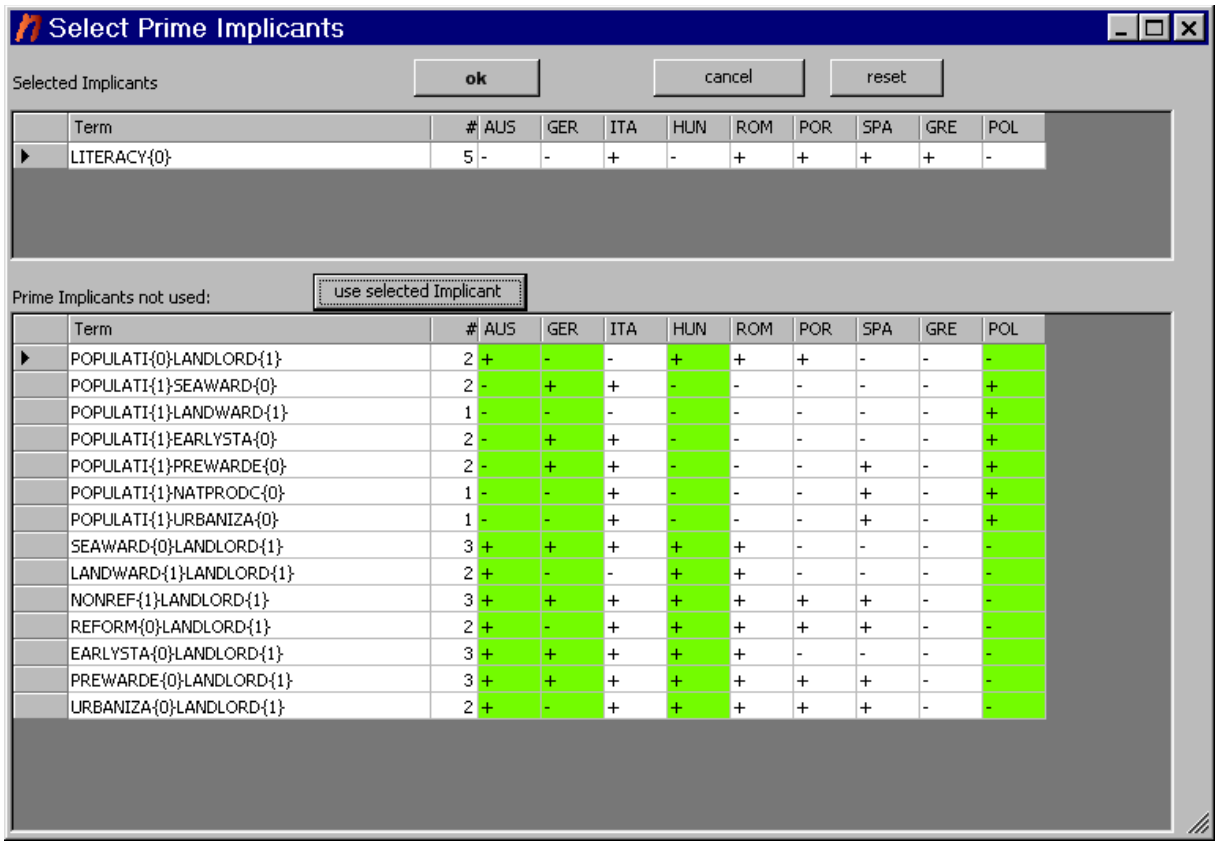
Start the calculation with the *Go* button (5). The result report will appear in a new window of the *Internet Explorer.* This window might be saved or printed.

Manual Selection of Prime Implicants

In the manual selection window prime implicants are selected. If there is a possible choice between prime implicants to find the minimal expression, these are displayed in the lower part of the window, whilst already selected implicants are displayed in the upper half. These are either selected by the user or by the software, indicating that these prime implicants have to be included in a minimal solution. Cases not represented by already selected implicants have green-colored columns to indicate this.

To select an implicant highlight it by selecting the row of the implicant with a mouse click and press the *use selected implicant* button. You may press the *reset* button to undo your selection(s).

When all cases are covered by the selected implicants the result report is called by pressing the *ok* button. The *cancel* button closes the manual selection window without creating a report.

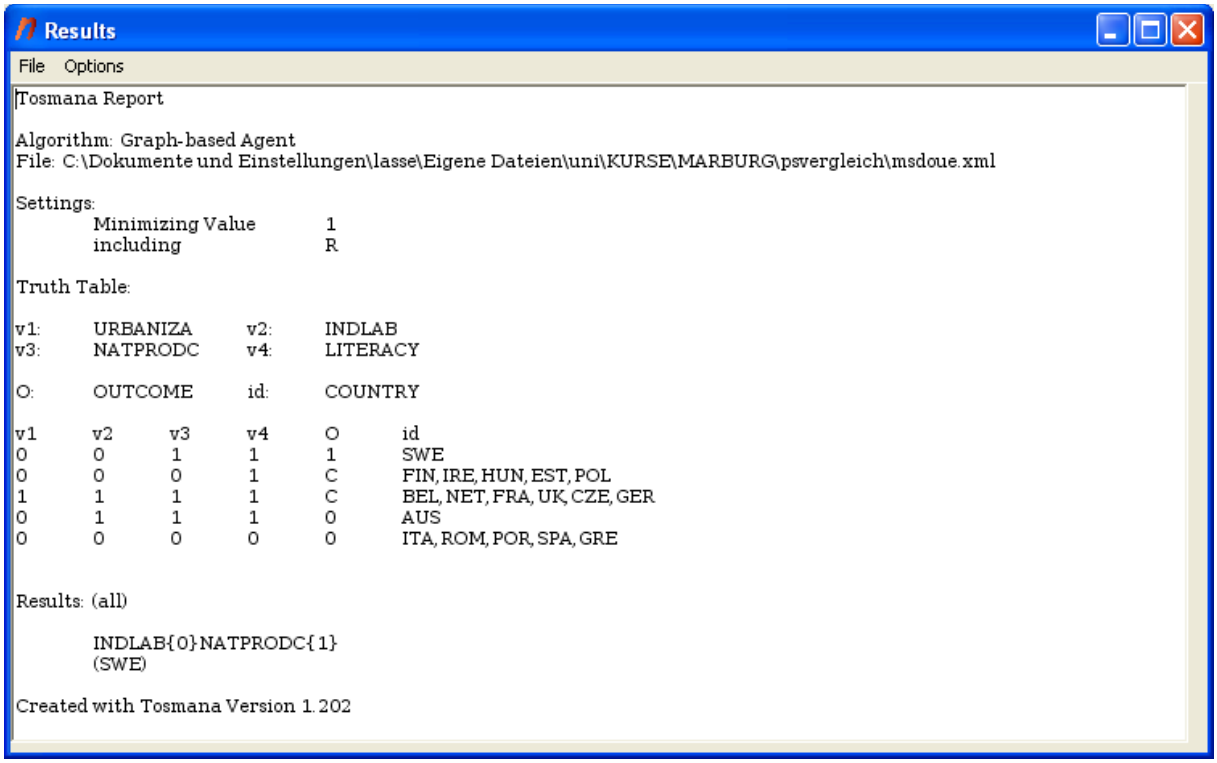


Term	#	AUS	GER	ITA	HUN	ROM	POR	SPA	GRE	POL
LITERACY{0}	5	-	-	+	-	+	+	+	+	-

Term	#	AUS	GER	ITA	HUN	ROM	POR	SPA	GRE	POL
POPULATI{0}LANDLORD{1}	2	+	-	-	+	+	+	-	-	-
POPULATI{1}SEAWARD{0}	2	-	+	+	-	-	-	-	-	+
POPULATI{1}LANDWARD{1}	1	-	-	-	-	-	-	-	-	+
POPULATI{1}EARLYSTA{0}	2	-	+	+	-	-	-	-	-	+
POPULATI{1}PREWARDE{0}	2	-	+	+	-	-	-	+	-	+
POPULATI{1}NATPRODC{0}	1	-	-	+	-	-	-	+	-	+
POPULATI{1}URBANIZA{0}	1	-	-	+	-	-	-	+	-	+
SEAWARD{0}LANDLORD{1}	3	+	+	+	+	+	-	-	-	-
LANDWARD{1}LANDLORD{1}	2	+	-	-	+	+	-	-	-	-
NONREF{1}LANDLORD{1}	3	+	+	+	+	+	+	+	-	-
REFORM{0}LANDLORD{1}	2	+	-	+	+	+	+	+	-	-
EARLYSTA{0}LANDLORD{1}	3	+	+	+	+	+	-	-	-	-
PREWARDE{0}LANDLORD{1}	3	+	+	+	+	+	+	+	-	-
URBANIZA{0}LANDLORD{1}	2	+	-	+	+	+	+	+	-	-

The Tosmana Report

When the calculation is finished, the result report opens in the Tosmana result window or, if selected, in the Internet Explorer:


Results
File Options
Tosmana Report
Algorithm: Graph-based Agent
File: C:\Dokumente und Einstellungen\lasse\Eigene Dateien\uni\KURSE\MARBURG\psvergleich\msdoue.xml
Settings:
Minimizing Value 1
including R
Truth Table:
v1: URBANIZA v2: INDLAB
v3: NATPRODC v4: LITERACY
O: OUTCOME id: COUNTRY
v1 v2 v3 v4 O id
0 0 1 1 1 SWE
0 0 0 1 C FIN, IRE, HUN, EST, POL
1 1 1 1 C BEL, NET, FRA, UK, CZE, GER
0 1 1 1 0 AUS
0 0 0 0 0 ITA, ROM, POR, SPA, GRE
Results: (all)
INDLAB{0}*NATPRODC{1}
(SWE)
Created with Tosmana Version 1.202

You will find the settings of the calculation and (if selected) the data matrix first in the report. At the end, the solution and (if the option is set) the simplifying assumptions are reported. Unlike in earlier QCA Software, *Tosmana* can either use upper-/lowercase notation to display the results or use strict set notation. As *Tosmana* also allows more than two possible values for each condition, the upper-/lowercase solution can only be used to display strictly dichotomous data sets.[3]

Any parts of the report can be copied to the clipboard and pasted to other application by clicking the right mouse button and selecting *copy* in the popup-menu.

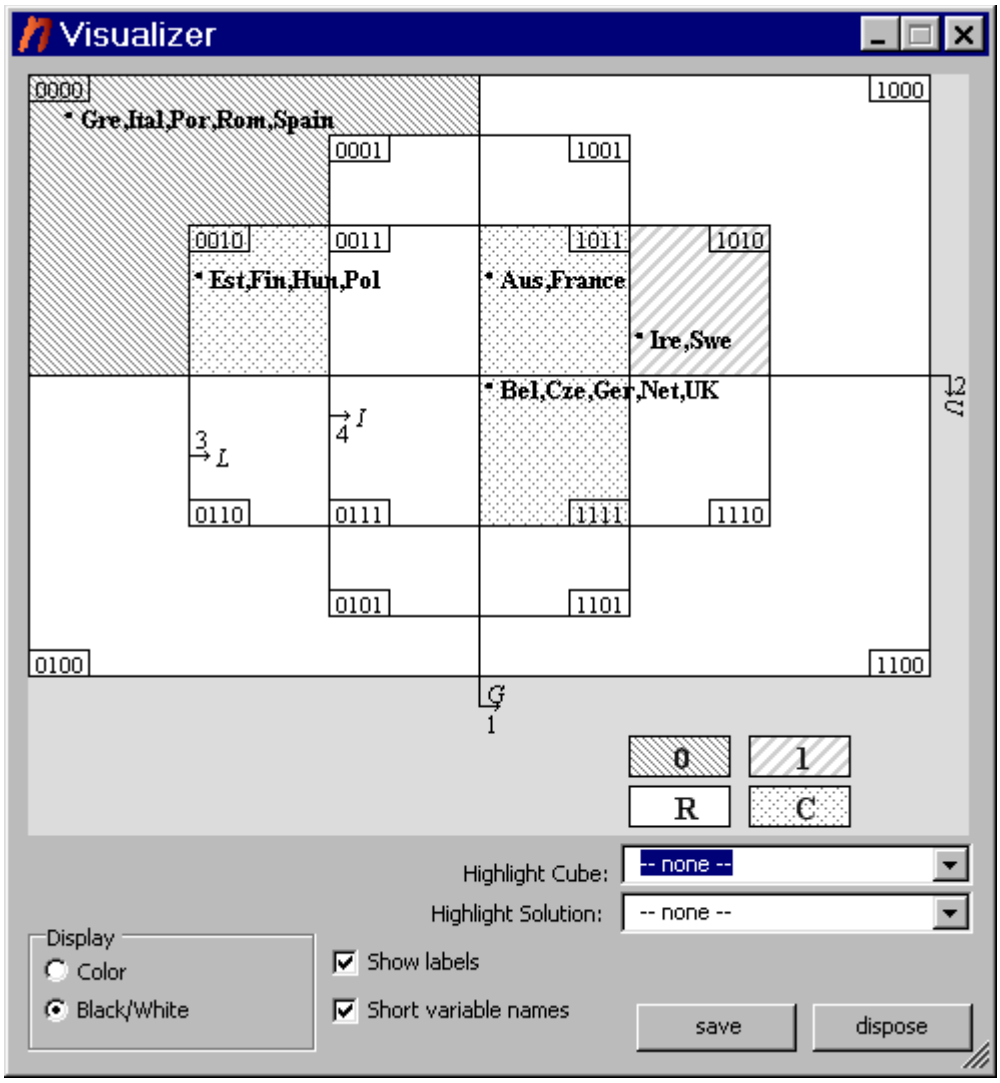
Also, solutions can be directly added to the Boolean Calculator by highlighting the solution and selecting *Add to Boolean Calculator* from the context menu pressing the right mouse button.[4]

[3] Please see Charles C. Ragin (1987): *The Comparative Method – Moving Beyond Qualitative and Quantitative Strategies* for the original detailed description of using Boolean sets in social science, and Gisèle DeMeur / Benoit Rihoux (2002): *L'analyse quali-quantitive comparée (AQQC-QCA : approche, techniques et applications en sciences humaines* for a introduction how to apply the method. The use of Set Notation is explained in Cronqvist, Lasse (2003): "Using Multi-Value Logic Synthesis in Social Science". Draft found on http://www.tosmana.net/resources.

[4] Currently this only works with dichotomous data sets. The use of set notation in the report is required (unselect the *Use Uppercase / Lowercase notation* option in the MVQCA window.

5. The Visualizer

Tosmana allows the user to display a Boolean data set with up to five independent conditions to be displayed graphically. To do this, select the conditions in the *MV(QCA)* window and press the *visualize* button. You will then get the Visualizer window.



Please note that at the recent stage it is only possible to save the created graph as a bitmap file, which is rather large, but this can be edited and compressed in almost every graphic suite. In the Visualizer, you can toggle between Colour and Black/White display and select which information is shown. You might also highlight solutions of your choice.

6. The Boolean Calculator

The Boolean Calculator allows simple calculation on Boolean Expressions like intersections and complements. To perform such a calculation, the Boolean Expressions have to be entered into the calculator. This is done in prefix notation just like using a standard pocket calculator: First the single expressions are entered which then are connected by + and *. When the logical expression is entered, it can be added to the lower calculation box by pressing the "add" button. An intersection of two logical expressions is calculated by selecting the two expressions from the expression list (using the shift key to select multiple entries) and then pressing the "computer intersection" button. The complement of a logical expression can be calculated by selecting the expression from the list and pressing the "compute complement" button.

From version 1.25 logical expressions can be directly added from the TOSMANA report (please see page 15 on this).

7. Registration and support)

Tosmana is free software and it comes as it is: There is no guarantee for correctness of any part of the program. Also, *Tosmana* comes to you on a *something-for-something* basis: The software is provided to you by the author, but you also should report errors or new ideas for the software, so that the software can be improved. To do so, please visit the *Tosmana* FAQ on http://www.tosmana.net/faq.html.

Registration

Tosmana is free, but we would like to know who uses *Tosmana.* Therefore we request you to register using the form online on http://register.tosmana.net. As a registered user you will be informed of changes in *Tosmana* and you will be able to ask for support on *Tosmana* if you have any questions on how to use it. You will receive a registration code when registered, which can be entered into *Tosmana.*

Support

If you have any trouble using *Tosmana* you may ask for support on the *Tosmana* web site. Please use the web forms provided there, as these are more easily processed than emails.

Updates

A mailing list has been set up to notice about TOSMANA updates (please see http://www.tosmana.net/joinlist.html).

8. Citing, Technical and contact information:

If you use *Tosmana* please cite like this:

> Cronqvist, Lasse. 2005. Tosmana – Tool for Small-N Analysis [Version 1.25]. Marburg. <http://www.tosmana.net>

Version of *Tosmana* covered by this manual:	1.25
Date of Software Release:	6th January 2006
Tosmana is developed by:	Lasse Cronqvist
Email:	cronqvis@staff.uni-marburg.de
Postal address:	Institute of Political Science University of Marburg 35032 Marburg Germany
Software Requirements:	.NET Framework (v. 1.0. or higher)
Download of *Tosmana*:	http://www.tosmana.net